General

Guideline Title

Energy expenditure: measuring resting metabolic rate (RMR) in the critically ill evidence-based nutrition practice guideline.

Bibliographic Source(s)

Academy of Nutrition and Dietetics. Energy expenditure: measuring resting metabolic rate (RMR) in the critically ill evidence-based nutrition practice guideline. Chicago (IL): Academy of Nutrition and Dietetics; 2013. Various p.

Guideline Status

This is the current release of the guideline.

This guideline meets NGC's 2013 (revised) inclusion criteria.

Recommendations

Major Recommendations

Ratings for the strength of the recommendations (Strong, Fair, Weak, Consensus, Insufficient Evidence), conclusion grades (I-V), and statement labels (Conditional versus Imperative) are defined at the end of the "Major Recommendations" field.

Energy Expenditure (EE): Thermic Effect of Feeding in Critically Ill

EE: Thermic Effect of Continuous Feeding in Critically Ill

Whether or not a critically ill patient is receiving continuous infusion of an energy source (e.g., energy-containing intravenous fluids or medications, enteral nutrition or parenteral nutrition), the registered dietitian nutritionist (RDN) may proceed with the indirect calorimetry measurement. Based on limited evidence comparing continuous feeding to fasting, the presence of a thermic effect of continuous feeding (TEF) is inconclusive. Waiting for infusion of an energy source or holding continuous feedings before conducting a measurement of resting metabolic rate (RMR), may not be necessary.

Weak, Conditional

EE: Thermic Effect of Bolus or Intermittent Feeding in Critically Ill

Following a bolus or intermittent feeding in the critically ill patient, the RDN should wait at least four hours to do an indirect calorimetry measurement. Delaying the indirect calorimetry measurement is recommended, because of the potential TEF during the post-absorptive state.

Consensus, Conditional

Recommendation Strength Rationale

- Conclusion statements are Grades III and V.

EE: Diurnal (Time of Day) Variation in Critically Ill

EE: Diurnal Variation in Critically Ill

If the critically ill patient is mechanically ventilated and receiving continuous feedings, then the RDN may conduct a measurement of RMR at any time of day, as long as resting conditions can be achieved. Likewise, if a measurement of total energy expenditure (TEE) is being considered, time of day does not need to be taken into account. Research indicates that there is no significant diurnal variation in either RMR or TEE in mechanically ventilated patients receiving continuous feedings. The effect of diurnal variation in critically ill patients who are not mechanically ventilated while receiving continuous feedings is unknown.

Fair, Conditional

Recommendation Strength Rationale

- Conclusion statement is Grade II.

EE: Gas Collection Devices in Critically Ill

EE: Gas Collection Devices in Critically Ill

If the critically ill patient is spontaneously breathing (not intubated or receiving supplemental oxygen), the registered dietitian nutritionist (RDN) should consider the canopy or hood to conduct a RMR measurement. Typically, the canopy or hood is reasonably tolerated by the patient, fits most patient circumstances and is most likely to produce a complete gas collection. However, patient circumstances or preference may require use of an alternative gas collection device.

Consensus, Conditional

Recommendation Strength Rationale

- Conclusion statement is Grade V.

EE: Room Conditions in Critically Ill

EE: Room Conditions for Measuring RMR in Critically Ill Patients

The RDN should ensure RMR is measured in a quiet, thermoneutral environment for the critically ill population. Cool room temperatures or drafts may generate shivering and nonshivering thermogenesis. Research is needed to define the range of thermoneutrality for the critically ill population.

Consensus, Imperative

Recommendation Strength Rationale

- Conclusion statements are Grade V.

EE: Body Positions in Critically Ill

EE: RMR Measurements in the Usual Body Position in Critically Ill

The RDN should conduct indirect calorimetry measurements in the critically ill patient who is in the semi-recumbent posture (standard position in the intensive care unit [ICU]). However, it is acceptable to measure the patient in the non-semi-recumbent position, if that is their usual body position. Limited research reports that posture can affect the accuracy of the measurement of RMR in some critically ill patients.

Fair, Imperative

EE: RMR Measurements after Changes in Usual Body Position in Critically Ill

In critically ill patients, if the patient's usual body position changes temporarily, the RDN should wait until the patient is moved back into the usual body position in order to perform indirect calorimetry. If the patient's usual body position changes to a new permanent position (e.g., change in head of bed elevation), the RDN should conduct a new indirect calorimetry measurement. See "Rest Period Duration for Measuring RMR" below.

Limited research reports that posture can affect the accuracy of the measurement of RMR in some critically ill patients.

Fair, Conditional

Recommendation Strength Rationale

- Conclusion statement is Grade III.

EE: Rest Period Duration in Critically Ill

EE: Rest Period Duration in Critically Ill

The RDN should ensure a 30-minute rest period prior to RMR measurement in critically ill patients. One study indicates that energy expenditure is elevated for up to 30 minutes after routine ICU care in non-sedated patients. The potential for sedation to shorten the rest period has not been studied.

Fair, Imperative

Recommendation Strength Rationale

- Conclusion statement is Grade III.

EE: Duration of Measurement (Steady State) in Critically Ill

EE: Duration of Measurement Related to Steady State in Critically Ill

When measuring energy expenditure in a critically ill patient, the RDN should discard the data for the first five minutes to exclude artifact and then achieve either a five-minute measure with up to 5% or a 25-minute measurement with up to 10% coefficient of variation (CV) in volume of oxygen (VO_2) and volume of carbon dioxide (VCO_2). Research indicates that these protocols are equivalent.

Strong, Imperative

EE: Measurement Duration if Unable to Achieve Steady State in Critically Ill

If unable to achieve steady state in critically ill patients, the RDN should take a single indirect calorimetry measurement extended for up to two hours or average two non-consecutive indirect calorimetry measurements within a 24-hour period. Research suggests that this protocol likely reflects 24-hour TEE with acceptable error.

Fair, Conditional

Recommendation Strength Rationale

- Conclusion statements are Grades I and II.

EE: Application of Respiratory Quotient (RQ) in Critically Ill

EE: RQ within the Physiologic Range in Critically Ill

If the RQ falls within the physiologic range (0.67 to 1.3) the RDN should not use RQ alone to reject the RMR measurement. Research shows that RQ can be manipulated within the physiologic range by changing respiratory parameters without altering the RMR measurement.

Fair, Imperative

EE: RQ outside the Physiologic Range in Critically Ill

If the RQ falls outside the physiologic range (below 0.67 or greater than 1.3), the RDN should suspect an error and repeat the RMR measurement. The physiologic range of RQ reflecting cellular metabolism is 0.67 to 1.3. Values for RQ outside of this range indicate an inaccurate RMR measurement.

Consensus, Conditional

EE: Limitations of RQ in Evaluating Feeding Levels in Critically Ill

The RDN should not rely solely on measured RQ to evaluate level or composition of feeding. Research demonstrates that RQ has poor accuracy

to evaluate under- and over-feeding. RQ can vary among individuals at any given feeding level and can be altered by factors unrelated to feeding.

Strong, Imperative

Recommendation Strength Rationale

- Conclusion statements are Grade II.

Definitions:

Conditional vs Imperative Recommendations

Recommendations are categorized in terms of either *conditional* or *imperative* statements. While conditional statements clearly define a specific situation, imperative statements are broadly applicable to the target population and do not impose restraints on their application.

Conditional recommendations are presented in an if/then format, such that:

If CONDITION then ACTION(S) because REASON(S)

Fulfillment of the condition triggers one or more guideline-specified actions. In contrast, imperative recommendations include terms such as "require," "must," and "should," and do not contain conditional text that would limit their applicability to specified circumstances.

Conclusion Grading Table

Strength of Evidence Elements	Grades				
	I Good/Strong	II Fair	III Limited	IV Expert Opinion Only	V Grade Not Assignable
Quality • Scientific rigor/validity • Considers design and execution	Studies of strong design for question Free from design flaws, bias and execution problems	Studies of strong design for question with minor methodological concerns OR Only studies of weaker study design for question	Studies of weak design for answering the question OR Inconclusive findings due to design flaws, bias or execution problems	No studies available Conclusion based on usual practice, expert consensus, clinical experience, opinion, or extrapolation from basic research	No evidence that pertains to question being addressed
Consistency Of findings across studies	Findings generally consistent in direction and size of effect or degree of association, and statistical significance with minor exceptions at most	Inconsistency among results of studies with strong design OR Consistency with minor exceptions across studies of weaker designs	Unexplained inconsistency among results from different studies OR Single study unconfirmed by other studies	Conclusion supported solely by statements of informed nutrition or medical commentators	NA
Quantity	One to several good quality	Several studies	Limited number of	Unsubstantiated by	Relevant

Strength of Evidence Elements • Number of studies • Number of subjects in studies	studies Grades I Large number of subjects studied Good/Strong Studies with negative results having sufficiently large sample size for adequate statistical power	by independent II investigators Fair Doubts about adequacy of sample size to avoid Type I and Type II error	studies III Low number of subjects studied and/or inadequate sample size within studies Limited	published studies IV Expert Opinion Only	studies have not V been done Grade Not Assignable
Clinical Impact • Importance of studied outcomes • Magnitude of effect	Studied outcome relates directly to the question Size of effect is clinically meaningful Significant (statistical) difference is large	Some doubt about the statistical or clinical significance of effect	Studied outcome is an intermediate outcome or surrogate for the true outcome of interest OR Size of effect is small or lacks statistical and/or clinical significance	Objective data unavailable	Indicates area for future research
Generalizability To population of interest	Studied population, intervention and outcomes are free from serious doubts about generalizability	Minor doubts about generalizability	Serious doubts about generalizability due to narrow or different study population, intervention or outcomes studied	Generalizability limited to scope of experience	NA

This grading system was based on the grading system from Greer, Mosser, Logan, & Wagstrom Halaas. A practical approach to evidence grading. Jt Comm J Qual Improv. 2000;26:700-712. In September 2004, The ADA Research Committee modified the grading system to this current version.

Criteria for Recommendation Rating

Statement Rating	Definition	Implication for Practice
Strong	A Strong recommendation means that the workgroup believes that the benefits of the recommended approach clearly exceed the harms (or that the harms clearly exceed the benefits in the case of a strong negative recommendation), and that the quality of the supporting evidence is excellent/good (grade I or II).* In some clearly identified circumstances, strong recommendations may be made based on lesser evidence when high-quality evidence is impossible to obtain and the anticipated benefits strongly outweigh the harms.	Practitioners should follow a Strong recommendation unless a clear and compelling rationale for an alternative approach is present.
Fair	A Fair recommendation means that the workgroup believes that the benefits exceed the harms (or that the harms clearly exceed the benefits in the case of a negative recommendation), but the quality of evidence is not as strong (grade II or III).* In some clearly identified circumstances, recommendations may be made based on lesser evidence when high-quality evidence is impossible to obtain and the anticipated benefits outweigh the harms.	Practitioners should generally follow a Fair recommendation but remain alert to new information and be sensitive to patient preferences.
Weak	A Weak recommendation means that the quality of evidence that exists is suspect or that well-done studies (grade I, II, or III)* show little clear advantage to one approach versus another.	Practitioners should be cautious in deciding whether to follow a recommendation classified as Weak, and should exercise judgment and

Statement Rating	Definition	Implication for Practice
		be alert to emerging publications that report evidence. Patient preference should have a substantial influencing role.
Consensus	A Consensus recommendation means that Expert opinion (grade IV)* supports the guideline recommendation even though the available scientific evidence did not present consistent results, or controlled trials were lacking.	Practitioners should be flexible in deciding whether to follow a recommendation classified as Consensus, although they may set boundaries on alternatives. Patient preference should have a substantial influencing role.
Insufficient Evidence	An Insufficient Evidence recommendation means that there is both a lack of pertinent evidence (grade V)* and/or an unclear balance between benefits and harms.	Practitioners should feel little constraint in deciding whether to follow a recommendation labeled as Insufficient Evidence and should exercise judgment and be alert to emerging publications that report evidence that clarifies the balance of benefit versus harm. Patient preference should have a substantial influencing role.

*Conclusion statements are assigned a grade based on the strength of the evidence. Grade I is good; grade II, fair; grade III, limited; grade IV signifies expert opinion only and grade V indicates that a grade is not assignable because there is no evidence to support or refute the conclusion. The evidence and these grades are considered when assigning a rating (Strong, Fair, Weak, Consensus, Insufficient Evidence - see chart above) to a recommendation.

Adapted by the Academy of Nutrition and Dietetics (AND) from the American Academy of Pediatrics, Classifying Recommendations for Clinical Practice Guideline, Pediatrics. 2004;114;874-877. Revised by the AND Evidence-Based Practice Committee, Feb 2006.

Clinical Algorithm(s)

An algorithm titled "Nutrition Assessment Algorithm" is provided in the original guideline document.

Scope

Disease/Condition(s)

Medical and surgical conditions in which the patient requires care in an intensive care unit (ICU), such as:

- Sepsis and systemic inflammatory response syndrome (SIRS)
- Trauma
- Neurological injury such as traumatic brain injury, stroke, amyotrophic lateral sclerosis (ALS), etc.
- Pancreatitis
- Respiratory failure
- Multi-organ failure
- Surgery
- Amputations
- Extreme obesity, underweight, or unusual stature
- Failure to wean from mechanical ventilation
- Paralysis

Guideline Category

Evaluation

Technology Assessment

Clinical Specialty

Critical Care

Internal Medicine

Nutrition

Intended Users

Advanced Practice Nurses

Allied Health Personnel

Dietitians

Hospitals

Nurses

Physician Assistants

Physicians

Respiratory Care Practitioners

Students

Guideline Objective(s)

Overall Objective

To provide practice guidelines for measuring resting metabolic rate (RMR) in the critically ill patient to improve accuracy of the indirect calorimetry measurement

Specific Objectives

- To define evidence-based recommendations for the measurement of RMR, using indirect calorimetry by registered dietitian nutritionists (RDNs) in collaboration with other healthcare providers
- To guide practice decisions that integrate medical and nutritional elements
- To reduce variations in measurement practices among RDNs
- To provide the RDN with evidence-based practice recommendations to adjust the medical nutrition therapy (MNT) or recommend other therapies to achieve positive outcomes
- To promote optimal nutrition support within cost constraints of the healthcare environment

Target Population

Critically ill patients (children and adults, 2 to 79 years of age) requiring or eligible for nutrition support in the intensive care unit (ICU)

Note: The evidence for the guideline did not specifically examine populations that were exclusively patients with burns, although many of the principles may apply. Some of the principles may apply to pediatric populations, but the evidence in this patient group was limited in the current project.

Interventions and Practices Considered

1. Indirect calorimetry measurement of resting metabolic rate (RMR) during continuous feeding or following bolus or intermittent feeding
2. Consideration of effects of diurnal variation (time of day) on RMR and total energy expenditure (TEE) measurements
3. Consideration of canopy or hood for gas collection in conducting RMR measurements
4. Ensuring RMR is measured in a quiet, thermoneutral environment
5. Conducting indirect calorimetry measurements in the patient's usual body position
6. Ensuring a 30-minute rest period prior to RMR measurement
7. Achieving a steady state in indirect calorimetry measurements (duration of measurements)
8. Application of respiratory quotient (RQ)

Major Outcomes Considered

- Diurnal variation
- Accuracy of resting metabolic rate (RMR) measurements related to the effects of different body positions
- Rest period duration prior to measurement of RMR
- Duration of the RMR measurement
- Accuracy of respiratory quotient (RQ)

Methodology

Methods Used to Collect/Select the Evidence

Hand-searches of Published Literature (Secondary Sources)

Searches of Electronic Databases

Description of Methods Used to Collect/Select the Evidence

General Methods for Collecting/Selecting the Evidence

The following list provides an overview of the steps which the Academy evidence analysis team goes through to identify research through database searches.

1. Plan the search strategy to identify the current best evidence relevant to the question. The plan for identification and inclusion of articles and reports should be systematic and reproducible, not haphazard. Write out the original search strategy and document adjustments to the strategy if they occur. Allow for several iterations of searches.
    - List inclusion and exclusion criteria. The work group will define the inclusion and exclusion criteria. These criteria will be used in defining the search strategy and for filtering the identified research reports. The Academy uses only peer-reviewed research; that is, articles accepted for evidence analysis must be peer-reviewed and published in a juried publication. Additionally, the Academy only uses human subjects in its research and does not include animal studies in its evidence analysis.
    - Identify search words. During the process of considering outcomes, interventions, nutrition diagnoses, and assessments, the work group may have identified a number of specific terms or factors that were important, but were not included in the actual question. These terms can be used as additional search terms to help identify relevant pieces of research. Both text word search and keyword search using Medical Subject Headings (MeSH) definitions may be used.
    - Identify databases to search. PubMed, Medline, CINAHL, EMBASE, Cochrane, Agricola, DARE, TRIP, AHRQ and ERIC are some common databases for clinical nutritional research. Note that search terms can vary depending on the database.
2. Conduct the search. Depending on the number and type of sources found in the initial search, adjustments might have to be made in the search strategy and to inclusion/exclusion criteria, and additional searches run. Changes to the search plan should be recorded for future reference. Document the number of sources identified in each search.
3. Review titles and abstracts. At this point, a filtering procedure is used to determine whether a research article matches the inclusion criteria and is relevant to the work group's questions. Typically, the lead analyst, along with a member of the expert workgroup, first reviews the citations and abstracts to filter out reports that are not applicable to the question. If a determination cannot be made based on the citation and abstract, then the full text of the article is obtained for review.

4. Gather all remaining articles and reports. Obtain paper or electronic copies of research articles that remain on the list following the citation and abstract review. If there are less than six citations, it could mean that the search was too specific to identify relevant research or that research has not been done on this topic. A broadened search should be tried. When there is a long list of citations, ascertain whether it includes articles that are tangential to the question or address the question in only a general way. In this case a more focused search strategy may be necessary.

Specific Methods for This Guideline

The recommendations in the guideline were based on a systematic review of the literature. Searches of Ovid MEDLINE were performed on the following topics:

- Thermic effect of feeding
- Diurnal variation
- Gas collection devices
- Room conditions
- Body positions
- Rest period duration
- Measurement duration (steady state)
- Application of Respiratory Quotient (RQ)

Each evidence analysis topic has a link to supporting evidence, where the Search Plan and Results can be found. Here, the reader can view when the search plan was performed, inclusion and exclusion criteria, search terms, databases that were searched and the excluded articles.

Number of Source Documents

The total number of supporting documents for all of the reviewed topics is below:

- Recommendations: 13
- Conclusion Statements: 12
- Evidence Summaries: 8
- Article Worksheets: 21

Methods Used to Assess the Quality and Strength of the Evidence

Weighting According to a Rating Scheme (Scheme Given)

Rating Scheme for the Strength of the Evidence

Conclusion Grading Table

Strength of Evidence Elements	Grades				
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Quality • Scientific rigor/validity • Considers design and execution	Studies of strong design for question Free from design flaws, bias and execution problems	Studies of strong design for question with minor methodological concerns OR	Studies of weak design for answering the question OR Inconclusive findings due to design flaws,	No studies available Conclusion based on usual practice, expert consensus, clinical experience, opinion, or extrapolation from basic research	No evidence that pertains to question being addressed

Strength of Evidence Elements	Grades				
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Consistency Of findings across studies	Findings generally consistent in direction and size of effect or degree of association, and statistical significance with minor exceptions at most	Inconsistency among results of studies with strong design OR Consistency with minor exceptions across studies of weaker designs	Unexplained inconsistency among results from different studies OR Single study unconfirmed by other studies	Conclusion supported solely by statements of informed nutrition or medical commentators	NA
Quantity • Number of studies • Number of subjects in studies	One to several good quality studies Large number of subjects studied Studies with negative results having sufficiently large sample size for adequate statistical power	Several studies by independent investigators Doubts about adequacy of sample size to avoid Type I and Type II error	Limited number of studies Low number of subjects studied and/or inadequate sample size within studies	Unsubstantiated by published studies	Relevant studies have not been done
Clinical Impact • Importance of studied outcomes • Magnitude of effect	Studied outcome relates directly to the question Size of effect is clinically meaningful Significant (statistical) difference is large	Some doubt about the statistical or clinical significance of effect	Studied outcome is an intermediate outcome or surrogate for the true outcome of interest OR Size of effect is small or lacks statistical and/or clinical significance	Objective data unavailable	Indicates area for future research
Generalizability To population of interest	Studied population, intervention and outcomes are free from serious doubts about generalizability	Minor doubts about generalizability	Serious doubts about generalizability due to narrow or different study population, intervention or outcomes studied	Generalizability limited to scope of experience	NA

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Methods Used to Analyze the Evidence

Description of the Methods Used to Analyze the Evidence

Step 1: Formulate Evidence Analysis Question

Specify a question in a defined area of practice or state a tentative conclusion or recommendation that is being considered. Include the patient type and special needs of the target population involved, the alternatives under consideration, and the outcomes of interest (PICO format).

Step 2: Gather and Classify Evidence

Conduct a systematic search of the literature to find evidence related to the question, gather studies and reports, and classify them by type of evidence. Classes differentiate primary reports of new data according to study design, and distinguish them from secondary reports that include systematic and/or narrative review.

Step 3: Critically Appraise Each Article

Review each article for relevance to the question and use the checklist of questions to evaluate the research design and implementation. Abstract key information from the report.

Step 4: Summarize Evidence

Synthesize the reports into an overview table and summarize the research relevant to the question.

Step 5: Write and Grade the Conclusion Statement

Develop a concise conclusion statement (the answer to the question). Assign a grade to indicate the overall strength or weakness of evidence informing the conclusion statement (see the "Rating Scheme for the Strength of the Evidence" field).

Methods Used to Formulate the Recommendations

Expert Consensus

Description of Methods Used to Formulate the Recommendations

Development of Evidence-Based Nutrition Practice Guidelines

The expert work group, which includes practitioners and researchers with a depth of experience in the specific field of interest, develops the disease-specific guideline. The guideline development involves the following steps:

1. Review the Conclusion Statements: The work group meets to review the materials resulting from the evidence analysis, which may include conclusion statements, evidence summaries, and evidence worksheets.
2. Formulate Recommendations for the Guideline Integrating Conclusions from Evidence Analysis: The work group uses an expert consensus method to formulate the guideline recommendations and complete the various sections on the recommendation page. These include:
    - Recommendation(s): This is a course of action for the practitioner. The recommendation is written using two brief and separate statements. The first statement is "what" the dietitian should do or not do. The second statement describes the "why" of the recommendation. More than one recommendation may be formulated depending on a particular topic and the supporting conclusion statements.
    - Rating: The rating for the recommendation is based on the strength of the supporting evidence. The grade of the supporting conclusion statement(s) will help determine this rating (see the "Rating Scheme for the Strength of the Recommendations" field).
    - Label of Conditional or Imperative: Each recommendation will have a label of "conditional" or "imperative." Conditional statements clearly define a specific situation, while imperative statements are broadly applicable to the target population without restraints on their pertinence.
    - Risks and Harms of Implementing the Recommendations: Includes any potential risks, anticipated harms or adverse consequences associated with applying the recommendation(s) to the target population.
    - Conditions of Application: Includes any organizational barriers or changes that would need to be made within an organization to apply

the recommendation in daily practice. Also includes any conditions which may limit the application of the recommendation(s). For instance, application may be limited to only people in an inpatient setting, or not applicable for pregnant women. Facilitators for the application of the guideline may also be listed here. Conditional recommendations will always have conditions specified. Imperative recommendations may have some general conditions for application.
    - Potential Costs Associated with Application: Includes any costs that may be associated with the application of this recommendation such as specialized staff, new equipment or treatments.
    - Recommendation Narrative: Provides a brief description of the evidence that supports this recommendation.
    - Recommendation Strength Rationale: Provides a brief list of the evidence strength and methodological issues that determined the recommendation strength.
    - Minority Opinions: If the expert work group cannot reach consensus on the recommendation, the minority opinions may be listed here.
    - Supporting Evidence: Provides links to the conclusions statements, evidence summaries and worksheets related to the formulation of this recommendation(s).
3. References Not Graded in the Academy's Evidence Analysis Process: Recommendations are based on the summarized evidence from the analysis. Sources that are not analyzed during the evidence analysis process may be used to support and formulate the recommendation or to support information under other categories on the recommendation page, if the workgroup deems necessary. References must be credible resources (e.g., consensus reports, other guidelines, position papers, standards of practice, articles from peer-reviewed journals, nationally recognized documents or websites). If recommendations are based solely on these types of references, they will be rated as "consensus." Occasionally recommendations will include references that were not reviewed during the evidence analysis process but are relevant to the recommendation, risks and harms of implementing the recommendation, conditions of application, or potential costs associated with application. These references will be listed on the recommendation page under "References Not Graded in the Academy's Evidence Analysis Process."
4. Develop a Clinical Algorithm for The Guideline: The workgroup develops a clinical algorithm based on Academy's Nutrition Care Process, to display how each recommendation can be used within the treatment process and how they relate to the Nutrition Assessment, Diagnosis, Intervention and Monitoring and Evaluation.
5. Complete the Writing of the Guideline: Each disease-specific guideline has a similar format which incorporates the Introduction (includes: Scope of the Guideline, Statement of Intent, Guideline Methods, Implementation, Benefits and Risks/Harms of Implementation), Background Information and any necessary Appendices. The work group develops these features.
6. Criteria Used in Guideline Development: The criteria used in determining the format and process for development of Academy's guidelines are based on the following tools and criteria for evidence-based guidelines:
    - Guideline Elements Model (GEM) which has been incorporated by the American Society for Testing and Materials (ASTM) as a Standard Specification for clinical practice guidelines.
    - Appraisal for Guidelines Research and Evaluation (AGREE) Instrument
    - National Guideline Clearinghouse www.guideline.gov .

Rating Scheme for the Strength of the Recommendations

Criteria for Recommendation Rating

Statement Rating	Definition	Implication for Practice
Strong	A Strong recommendation means that the workgroup believes that the benefits of the recommended approach clearly exceed the harms (or that the harms clearly exceed the benefits in the case of a strong negative recommendation), and that the quality of the supporting evidence is excellent/good (grade I or II).* In some clearly identified circumstances, strong recommendations may be made based on lesser evidence when high-quality evidence is impossible to obtain and the anticipated benefits strongly outweigh the harms.	Practitioners should follow a Strong recommendation unless a clear and compelling rationale for an alternative approach is present.
Fair	A Fair recommendation means that the workgroup believes that the benefits exceed the harms (or that the harms clearly exceed the benefits in the case of a negative recommendation), but the quality of evidence is not as strong (grade II or III).* In some clearly identified circumstances, recommendations may be	Practitioners should generally follow a Fair recommendation but remain alert to new information and be sensitive to patient preferences.

Statement Rating	Definition	Implication for Practice
	made based on lesser evidence when high-quality evidence is impossible to obtain and the anticipated benefits outweigh the harms.	
Weak	A Weak recommendation means that the quality of evidence that exists is suspect or that well-done studies (grade I, II, or III)* show little clear advantage to one approach versus another.	Practitioners should be cautious in deciding whether to follow a recommendation classified as Weak, and should exercise judgment and be alert to emerging publications that report evidence. Patient preference should have a substantial influencing role.
Consensus	A Consensus recommendation means that Expert opinion (grade IV)* supports the guideline recommendation even though the available scientific evidence did not present consistent results, or controlled trials were lacking.	Practitioners should be flexible in deciding whether to follow a recommendation classified as Consensus, although they may set boundaries on alternatives. Patient preference should have a substantial influencing role.
Insufficient Evidence	An Insufficient Evidence recommendation means that there is both a lack of pertinent evidence (grade V)* and/or an unclear balance between benefits and harms.	Practitioners should feel little constraint in deciding whether to follow a recommendation labeled as Insufficient Evidence and should exercise judgment and be alert to emerging publications that report evidence that clarifies the balance of benefit versus harm. Patient preference should have a substantial influencing role.

*Conclusion statements are assigned a grade based on the strength of the evidence. Grade I is good; grade II, fair; grade III, limited; grade IV signifies expert opinion only and grade V indicates that a grade is not assignable because there is no evidence to support or refute the conclusion. The evidence and these grades are considered when assigning a rating (Strong, Fair, Weak, Consensus, Insufficient Evidence - see chart above) to a recommendation.

Adapted by the Academy of Nutrition and Dietetics (AND) from the American Academy of Pediatrics, Classifying Recommendations for Clinical Practice Guideline, Pediatrics. 2004;114;874-877. Revised by the AND Evidence-Based Practice Committee, Feb 2006.

Cost Analysis

A formal cost analysis was not performed and published cost analyses were not reviewed.

Method of Guideline Validation

External Peer Review

Internal Peer Review

Description of Method of Guideline Validation

Each guideline is reviewed internally and externally using the Appraisal for Guidelines Research and Evaluation (AGREE) Instrument as the evaluation tool. The external reviewers consist of an interdisciplinary group of individuals (may include dietitians, doctors, psychologists, nurses, etc.). The guideline is adjusted by consensus of the expert panel and approved by Academy's Evidence-Based Practice Committee prior to publication on the Evidence Analysis Library (EAL).

Evidence Supporting the Recommendations

Type of Evidence Supporting the Recommendations

The type of supporting evidence is identified and graded for each recommendation (see the "Major Recommendations" field).

The guideline contains conclusion statements that are supported by evidence summaries and evidence worksheets. These resources summarize the important studies (randomized controlled trials [RCTs], clinical studies, observational studies, cohort and case-control studies) pertaining to the conclusion statement and provide the study details.

Benefits/Harms of Implementing the Guideline Recommendations

Potential Benefits

The primary goal of implementing these recommendations includes improving the percentage of individuals who are able to meet their nutritional needs and positively impact the patient's treatment and clinical outcomes.

Potential Harms

Overall Risk/Harm Considerations

- Safety issues should be considered for each recommendation.
- Failure to measure the resting metabolic rate (RMR) accurately may result in incorrect diagnosis of the energy state, inaccurate therapy for patients who want to gain or lose body weight, or overfeeding or underfeeding of critically ill patients.
- Not following the guideline may result in inappropriate nutrition support due to inaccurate RMR measurement.
- Moving the patient only for the measurement of indirect calorimetry may increase the risk of injury, pain, and negative health outcomes to patients.

Technical Factors That Decrease the Accuracy of Indirect Calorimetry Measurements

- Mechanical ventilation with fraction of inspired oxygen (FIO_2) ≥60% or unstable FIO_2 (>±0.01)
- Mechanical ventilation with positive end-expiratory pressure (PEEP) >12 cm H_2O
- Hyperventilation or hypoventilation
- Sampling system leak
- Excessive moisture in the indirect calorimetry system
- Failure to collect all expiratory flow (e.g., bronchopleural fistula, chest tube leak, etc.)
- Supplemental oxygen in spontaneously breathing patients
- Hemodialysis in progress
- Calibration errors

See also "Factors to Consider Before, During, and After an RMR Measurement" in the original guideline document under "Benefits and Risks/Harms of Implementation."

Contraindications

Contraindications

If the patient is dependent on supplemental oxygen, do not attempt to measure resting metabolic rate (RMR). With supplemental oxygen, the indirect calorimeter will provide invalid measurements of RMR.

Qualifying Statements

Qualifying Statements

- This nutrition practice guideline is meant to serve as a general framework for handling clients with particular health problems. The independent skill and judgment of the health care provider must always dictate treatment decisions.
- While evidence-based nutrition practice guidelines represent a statement of best practice based on the latest available evidence at the time of publishing, they are not intended to overrule professional judgment. Rather, they may be viewed as a relative constraint on individual clinician discretion in a particular clinical circumstance. These nutrition practice guidelines are provided with the express understanding that they do not establish or specify particular standards of care, whether legal, medical or other.
- This guideline recognizes the role of patient preferences for possible outcomes of care, when the appropriateness of a clinical intervention involves a substantial element of personal choice or values. With regard to types of evidence that are associated with particular outcomes, two major classes have been described. Patient-oriented evidence that matters (POEM) deals with outcomes of importance to patients, such as changes in morbidity, mortality or quality of life. Disease-oriented evidence (DOE) deals with surrogate end-points, such as changes in laboratory values or other measures of response. Although the results of DOE sometimes parallel the results of POEM, they do not always correspond. When possible, the Academy of Nutrition and Dietetics recommends using POEM-type evidence rather than DOE. When DOE is the only guidance available, the guideline indicates that key clinical recommendations lack the support of outcomes evidence.

Implementation of the Guideline

Description of Implementation Strategy

The publication of this guideline is an integral part of the plans for getting the Academy of Nutrition and Dietetics evidence-based recommendations on critical illness to all dietetics practitioners engaged in, teaching about or researching Measuring Resting Metabolic Rate (RMR) in the Critically Ill as quickly as possible. National implementation workshops at various sites around the country and during the Academy Food Nutrition Conference Expo (FNCE) are planned. Additionally, there are recommended dissemination and adoption strategies for local use of the Academy's Measuring Resting Metabolic Rate (RMR) in the Critically Ill Evidence-Based Nutrition Practice Guideline.

The guideline development team recommended multi-faceted strategies to disseminate the guideline and encourage its implementation. Management support and learning through social influence are likely to be effective in implementing guidelines in dietetic practice. However, additional interventions may be needed to achieve real change in practice routines.

Implementation of the Measuring Resting Metabolic Rate (RMR) in the Critically Ill Evidence-Based Nutrition Practice Guideline will be achieved by announcement at professional events, presentations and training. Some strategies include:

- National and local events: State dietetic association meetings and media coverage will help launch the guideline.
- Local feedback adaptation: Presentation by members of the work group at peer review meetings and opportunities for continuing education units (CEUs) for courses completed.
- Education initiatives: The guideline and supplementary resources will be freely available for use in the education and training of dietetic interns and students in approved Accreditation Council for Education in Nutrition and Dietetics (ACEND) programs.
- Champions: Local champions will be identified and expert members of the recommendation team will prepare articles for publications. Resources will be provided that include PowerPoint presentations and pre-prepared case studies.
- Practical tools: Some of the tools that will be developed to help implement the guideline include specially designed resources such as clinical algorithms, a tool kit, and a slide presentation.

Specific distribution strategies include:

Publication in full: The guideline will be available electronically at the Academy Evidence Analysis Library Web site and will be announced to all Academy Dietetic Practice Groups. The Academy Evidence Analysis Library will also provide downloadable supporting information.

Implementation Tools

Clinical Algorithm

Quick Reference Guides/Physician Guides

For information about availability, see the *Availability of Companion Documents* and *Patient Resources* fields below.

Institute of Medicine (IOM) National Healthcare Quality Report Categories

IOM Care Need

Getting Better

IOM Domain

Effectiveness

Identifying Information and Availability

Bibliographic Source(s)

Academy of Nutrition and Dietetics. Energy expenditure: measuring resting metabolic rate (RMR) in the critically ill evidence-based nutrition practice guideline. Chicago (IL): Academy of Nutrition and Dietetics; 2013. Various p.

Adaptation

Not applicable: The guideline was not adapted from another source.

Date Released

2013

Guideline Developer(s)

Academy of Nutrition and Dietetics - Professional Association

Source(s) of Funding

Academy of Nutrition and Dietetics

Guideline Committee

Energy Expenditure: Measuring Resting Metabolic Rate (RMR) in the Critically Ill Evidence-Based Nutrition Practice Guideline Expert Work Group

Composition of Group That Authored the Guideline

Expert Workgroup Members: Sue Davies, PhD, DCN, MPH, RD (*Chair*); Carrie Earthman, PhD, RD; David Frankenfield, MS, RD, CNSD; Susan Fullmer, PhD, RD, CD; Abigail Coleman, MS, RD, CNSD (resigned December 2011); Peggy Lee, MSc, RD, CNSC (joined June 2012); Kate Wilcutts, MS, RD, CNSD (resigned September 2012); Jillian Trabulsi, PhD, RD (joined September 2012)

Financial Disclosures/Conflicts of Interest

In the interest of full disclosure, the Academy has adopted the policy of revealing relationships workgroup members have with companies that sell products or services that are relevant to this topic. Workgroup members are required to disclose potential conflicts of interest by completing the Academy Conflict of Interest Form. It should not be assumed that these financial interests will have an adverse impact on the content, but they are noted here to fully inform readers.

None of the workgroup members listed above disclosed potential conflicts.

Guideline Status

This is the current release of the guideline.

This guideline meets NGC's 2013 (revised) inclusion criteria.

Guideline Availability

Electronic copies: Available to members from the Academy of Nutrition and Dietetics Web site .

Availability of Companion Documents

The following is available:

- Energy expenditure: measuring resting metabolic rate (RMR) in the critically ill evidence-based nutrition practice guideline. Executive summary of recommendations. Chicago (IL): Academy of Nutrition and Dietetics; 2013. Electronic copies: Available from the Academy of Nutrition and Dietetics (AND) Web site .

Patient Resources

None available

NGC Status

This NGC summary was completed by ECRI Institute on January 15, 2015.

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